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## Advanced Placement Course-Taking and ACT Testing Outcomes in Arkansas

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**ARKANSAS EDUCATION REPORT**  
**VOLUME 18, ISSUE 3**

**ADVANCED PLACEMENT COURSE-TAKING AND ACT**  
**TEST OUTCOMES IN ARKANSAS**

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**November 18, 2020**

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# **EXECUTIVE SUMMARY**

This report examines trends in Advanced Placement (AP) course-taking in Arkansas. The AP program allows students to access college-level content while still enrolled in high school. Using de-identified student-level data from 2015-16 to 2017-18 from the Arkansas Department of Education, this research investigates whether students who take AP courses demonstrate better college readiness and examines how these trends vary for different demographic and socioeconomic groups throughout the state. While we cannot estimate the causal effect of AP coursework on student outcomes, this study presents key findings related to the Advanced Placement program which are relevant to policymakers and educators in Arkansas.

## **I. Which types of students participate in Advanced Placement in Arkansas?**

- a. Approximately 34% of students in our dataset enrolled in at least one core content AP course between 9<sup>th</sup>-11<sup>th</sup> grade. AP participation rates vary significantly across different regions in Arkansas.
- b. On average, the majority of AP-Takers in Arkansas are White, female, or students who qualify for gifted and talented services. Advanced Placement students are also more likely to have higher prior achievement scores compared to those who don't participate in the courses. Students who do not enroll in AP courses are more likely to be Black or Hispanic, have limited English proficiency, or qualify for free- or reduced-price lunch.

## **II. What is the relationship between enrollment in a core content AP course between 9<sup>th</sup> and 11<sup>th</sup> grade and performance on the ACT for students in Arkansas?**

- a. On average, students who select into AP courses in 9<sup>th</sup> -11<sup>th</sup> grade earn higher ACT composite scores relative to their peers, even when controlling for covariates including demographics and prior achievement. AP-Takers, on average, score almost two points higher on their ACT exam relative to Non-AP Takers.
- b. This result is clustered around the 19-point cut score required for students to opt out of remedial math and English courses during their freshman year of college in Arkansas. In other words, most AP-Takers score just above the remediation threshold and Non-AP Takers score just below with the exception of gifted & talented students, who always score above the threshold, and Black students, who always score below the threshold, regardless of AP participation.

## **III. Are there disproportionalities in ACT outcomes for AP and Non-AP Takers across different demographic groups and regions in Arkansas?**

- a. This study finds evidence of heterogeneity in treatment effect for different racial and socioeconomic groups. Subgroups from racially diverse or economically disadvantaged backgrounds both score lower on the ACT, on average, and experience smaller increases in ACT composite score when taking AP courses, compared to their economically advantaged, White peers.

## **I. INTRODUCTION**

This report examines trends in Advanced Placement (AP) course-taking in Arkansas. The AP program allows students to access college-level content while still enrolled in high school. Using de-identified student-level data from 2015-16 to 2017-18 from the Arkansas Department of Education, this research investigates whether students who take AP courses demonstrate better college readiness – as determined by the ACT exam – and examines how these trends vary for different demographic and socioeconomic groups throughout the state.

### *Trends in Advanced Placement Participation Over Time*

The Advanced Placement (AP) program is a nationwide curriculum offering that provides high school students the opportunity to access rigorous, college-level content while still enrolled in secondary school. Students enrolled in AP may ultimately earn college credits for their performance on standardized end-of-course exams (Warne, 2017). The Advanced Placement program was first conceived by the College Board in the 1950s to provide high-value learning opportunities to an elite subset of students.

In recent years, AP has grown to target traditionally underserved students as a way to close achievement gaps in both access to higher education and student outcomes (Finn & Scanlon, 2019). As a result of this targeting, the scale of AP coursework in American schools has grown exponentially in recent decades to serve nearly three million students nationwide.

The push to increase the number of traditionally underserved students enrolled in AP has led states to enact policies to ensure increased access to AP courses. One such policy – Arkansas Act 102 – which passed in 2003, mandates universal statewide access to AP coursework in the four core disciplines: math, English, science and social studies (“four core”). To do this, each

district was required to offer one AP class in the four core, and each public high school was to provide a minimum of four AP classes, by 2008.

The legislation also required regular approved training for AP and pre-AP teachers, and appropriated funds to cover the testing fee for any Arkansas students taking an AP exam, regardless of socioeconomic status (Office for Education Policy, 2016). In 2003, approximately 43% of schools offered four or more AP classes (Arce-Trigatti, 2018). By 2008, when the mandate went into full effect, the number of schools offering four or more AP courses had risen to around 97% and student participation had increased proportionally.

#### *Prior Literature on Advanced Placement & Student Outcomes*

By increasing access to AP courses, policymakers believe they will see improvement in a variety of student outcomes. Prior research suggests students who take AP coursework will outperform their peers on standardized tests and show that these effects are heterogenous across different student groups (Scott et al., 2010). However, research on postsecondary outcomes is mixed. While some research shows that AP participants are more likely to enroll in a four-year college, earn higher college GPAs, and attain Bachelor's degrees at higher rates (Flowers, 2008; Chawjewski, Matter, & Shaw, 2011; Dougherty et al., 2011); others find that the number of AP courses a student takes is not a good indicator of their later performance (Geiser & Santelices, 2004). In addition, a 2011 study shows that students in low-income urban high schools do not feel more prepared for college after taking AP courses (Hallet & Venegas).

This study examines the relationship between Advanced Placement course-taking and the college readiness of Arkansas high schoolers, as measured by the ACT exam. The ACT exam provides a reasonable choice for measuring college readiness since it is widely used by colleges

as part of their entrance criteria. The ACT is also used in Arkansas to determine eligibility for a number of scholarship programs and whether students are required to participate in college remediation courses.

In order to study the role of AP course-taking in college readiness, this investigation specifically attempts to answer the following questions:

- Which types of students participate in Advanced Placement in Arkansas?
- What is the relationship between enrollment in a core content AP course between 9<sup>th</sup> and 11<sup>th</sup> grade and performance on the ACT for students in Arkansas?
- Are there disproportionalities in AP participation and college readiness across different demographic groups and geographic regions in Arkansas?

## **II. DATA**

This analysis uses de-identified student-level data from the Arkansas Department of Education. Four types of data are combined to complete the investigation: ACT score information from the annual school-day ACT exam given in April to 11<sup>th</sup> graders across the state, course enrollment data, student demographics, and prior achievement information. All analyses use ACT data from 2016, 2017, and 2018. Years prior to 2016 are omitted, as 2016 was the first year Arkansas offered the ACT at no cost to 11<sup>th</sup> grade students during the school day. In Arkansas, participation in the ACT school-day exam after 2016 has been above 90% statewide<sup>1</sup>.

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<sup>1</sup> Source: Author's calculations.

For the purposes of this investigation we focus on ACT composite scores, however the dataset also includes information on sub-scores from the math, science, reading, and writing specific sections of the exam.

The dataset also includes information on course enrollment for all students in Arkansas public schools between the years 2014-2018. This data includes all courses a student took, as well as the grades they received quarterly and overall in each course. Student demographic information includes gender, race, gifted and talented status, free- or reduced-price lunch eligibility, and limited English proficiency status; in addition to school and district descriptors. Prior achievement is restricted to results from the 7th grade Benchmark exam in math and reading, which are standardized within content area at the student level using a z-score<sup>2</sup>.

The analytic sample consists of 76,557 eleventh grade students who attended an Arkansas public school between 2016 and 2018 and had complete ACT, prior achievement, demographic, and enrollment data.<sup>3</sup> This sample includes 24,901 students who took at least one AP core content course between 9<sup>th</sup>-11<sup>th</sup> grade (AP-Takers) and 51,656 students who did not take any AP core content courses (Non-AP Takers).

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<sup>2</sup> The Benchmark exam was a statewide achievement exam that was administered each spring to grades 3-8 between 2004 and 2015 (Office For Education Policy, 2019). The 7th grade assessment was chosen for three reasons. First, beginning as early as 8th grade some students may begin enrolling in pre-AP coursework, therefore restricting to 7th grade ensures students have not had exposure to the program. Second, 8<sup>th</sup> grade testing was changed from the Benchmark exam to the PARCC exam during our study years, while 7<sup>th</sup> graders were consistently tested with the Benchmark exam. For ease of interpreting, using one exam spanning all study years is preferable. Finally, about 30% of 8th-graders are accelerated in math, taking Algebra I, which results in a pronounced ceiling effect on 8<sup>th</sup> grade math Benchmark exams. As a result, the 8<sup>th</sup> grade Benchmark exam fails to capture variation at the highest levels of achievement.

<sup>3</sup> Students who took the ACT as 10<sup>th</sup> or 12<sup>th</sup> graders are omitted from the sample. A large portion of the original data were missing either ACT or 7<sup>th</sup> grade Benchmark scores for students – these individuals were determined to have moved into and out of the dataset over time (for example students who moved into or out of state between 7<sup>th</sup> & 11<sup>th</sup> grade). Analysis determines this attrition was not systemic in nature and does not pose a threat to the validity of this study.



### **III. TRENDS IN ADVANCED PLACEMENT AND ACT IN ARKANSAS**

Tables 1-3 provide descriptive statistics for AP-Takers and Non-AP Takers who were enrolled in 11<sup>th</sup> grade between the 2016 and 2018 school years in Arkansas. Students who enroll in Advanced Placement courses are noticeably different on observable characteristics relative to their Non-AP peers (Table 1).

*Table 1: Characteristics of Arkansas AP-Takers compared to Non-AP Takers, 2016-2018*

	<b>AP-Takers</b>	<b>Non-AP Takers</b>	<b>Difference (AP vs. Non-AP)</b>
% Female	59.8	45.7	14.1***
% White	70.0.	63.9	6.1***
% Hispanic	8.7	11.4	-2.7***
% Black	16.9	21.6	-4.7***
% Other Races	4.7	4.0	0.1***
% Gifted & Talented	20.7	4.7	16.0***
% ELL	2.3	6.7	-4.4***
% FRL	40.7	58.5	-17.8***
7 <sup>th</sup> Math Z-score	0.676	-0.148	0.823***
7 <sup>th</sup> RLA Z-score	0.640	-0.146	0.786***
N	24,901	51,656	--

*Note.* \*\*\* Indicates differences are statistically significant at the 1% significance level.

On average, AP-Takers in Arkansas are more likely to be White, female, or qualify for gifted and talented services. Advanced Placement students also tend to have higher prior achievement scores compared to those who don't participate in the courses. Those who don't enroll in AP are more likely to be Black or Hispanic, have limited English proficiency, or qualify for free- or reduced-price lunch. These differences are statistically significant at the one percent significance level.

Table 2 describes the trends in ACT composite scores, overall and by AP designation, for the state and each of the five geographic regions of the state: Northwest, Northeast, Central, Southwest, and Southeast. On average, the ACT composite score for the pooled sample of 11<sup>th</sup> graders in 2016-2018 in Arkansas is an 18.9, which is lower than the national average of 20.9 during those same years ([The ACT, 2018](#)). Statistical analysis shows no significant difference between the mean ACT score in each year separately, when compared to the mean ACT score for all years combined.

Table 2 also depicts variance in mean ACT score across different regions of Arkansas. Northwest Arkansas 11<sup>th</sup> graders have the highest mean ACT composite score, while students in the Southeast region score lowest overall. The table also shows the mean ACT score for Advanced Placement students in each region, compared to those who did not take AP courses. Large, statistically significant gaps in ACT performance exist for AP-Takers versus Non-AP Takers in all five regions, with the largest gap appearing in the Central region of the state.

*Table 2: Trends in 11th Grade ACT Composite Scores & AP Course-Taking Overall and by Region, 2016-2018*

	<b>Statewide</b>	<b>Northwest Arkansas</b>	<b>Northeast Arkansas</b>	<b>Central Arkansas</b>	<b>Southwest Arkansas</b>	<b>Southeast Arkansas</b>
Proportion AP-Takers	0.34	0.33	0.28	0.35	0.36	0.39
Mean ACT	18.90	19.60	18.60	18.90	17.90	17.30
Mean ACT (AP)	22.00	22.74	22.17	22.21	20.64	19.73
Mean ACT (Non-AP)	17.40	18.45	17.09	16.93	16.24	15.69
<i>Difference (AP vs. Non-AP)</i>	<i>4.60***</i>	<i>4.29***</i>	<i>5.08***</i>	<i>5.28***</i>	<i>4.40***</i>	<i>4.04***</i>
N	76,557	27,464	15,294	22,073	7,459	4,267

Finally, AP course-taking as a proportion of total 11<sup>th</sup> grade population between 2016-2018 is also displayed in Table 2. On average, about 34% of students statewide enroll in an AP course in the four core disciplines between 9<sup>th</sup> -11<sup>th</sup> grade. There is also variation in AP participation across regions. Interestingly, Southeast Arkansas, where ACT achievement is lowest, has the highest proportion of students taking Advanced Placement courses in the four core disciplines. Northeast Arkansas has the lowest participation in AP courses with only 28% of students electing to enroll.

Subgroup participation for AP-Takers varies substantially by region as well (Table 3). Northeast Arkansas has the highest percentage of White (82.7%) and Hispanic (16.2%) students taking AP courses, but the lowest participation by Black students (1.7%). Southeast Arkansas has the highest percentage of Black students (38.8%), female students (62.2%) and students in poverty (61.6%) taking Advanced Placement. Concerningly, comparisons between state and

regional demographic distributions show that AP students do not appear to be representative of the overall population within each region. This evidence suggests access to AP coursework is less universal and more subjective.

Table 3: Subgroup Participation in Advanced Placement Coursework Compared to Overall Demographics by Region, 2016-18

Region	Group	% Female	% White	% His-panic	% Black	% Other Race	% GT	% ELL	% FRL	7 <sup>th</sup> zMath	7 <sup>th</sup> zRLA	N
Statewide	All	50.0	65.1	10.5	20.2	4.2	9.7	5.3	53.0	0.107	0.098	76,557
	AP	59.8	70.0	8.7	16.9	4.7	20.7	2.3	40.7	0.676	0.640	24,901
	Diff.	9.8	4.9	-1.8	-3.3	0.5	11.0	-3.0	-12.3	0.533	0.542	-
NW	All	50.0	71.8	18.1	3.1	7.0	9.0	10.0	50.1	0.305	0.298	27,464
	AP	58.5	74.6	16.2	1.7	7.5	18.6	4.8	37.9	0.783	0.743	7,653
	Diff.	8.5	2.8	-1.9	-1.4	0.5	9.6	-5.2	-12.2	0.478	0.445	-
NE	All	50.6	75.3	3.9	18.9	1.9	9.6	1.1	57.5	0.107	0.117	15,294
	AP	61.1	82.7	3.2	12.9	2.1	22.0	<1	46.2	0.717	0.674	4,530
	Diff.	10.5	7.4	-0.7	-6.0	0.2	12.4	0.1	-11.3	0.610	0.557	-
Central	All	51.4	43.4	6.1	33.9	3.4	11.4	2.6	45.4	0.117	0.095	22,073
	AP	60.0	63.3	5.5	26.4	4.8	22.1	1.5	33.8	0.677	0.607	8,165
	Diff.	8.6	19.9	-0.6	-7.5	1.4	10.7	-1.1	-11.6	0.56	0.512	-
SW	All	49.9	57.3	10.8	29.6	2.3	11.3	4.7	60.3	-0.024	0.033	7,459
	AP	59.2	65.4	8.4	23.3	2.9	21.7	1.6	46.5	0.489	0.542	2,822
	Diff.	9.3	8.1	-2.4	-6.3	0.6	10.4	-3.1	-13.8	0.513	0.509	-
SE	All	50.5	48.5	6.5	43.6	1.4	10.1	2.3	67.2	-0.042	-0.078	4,267
	AP	62.2	53.8	5.7	38.8	1.7	18.8	1.4	61.6	0.392	0.417	1,731
	Diff.	11.7	5.3	-0.8	-4.8	0.3	8.7	-0.9	-5.6	0.434	0.495	-

## **IV. EMPIRICAL APPROACH**

The research design for this investigation is selection on observables employing a multiple linear regression model to estimate parameters. For this analysis the intervention is defined as taking any AP core class between freshman year and junior year. Senior year is eliminated because students take the school-day ACT exam during the Spring of 11<sup>th</sup> grade. The comparison group is therefore students who did not take any AP core courses between their freshman and junior year. The outcome of interest is the relationship between selection into a core content AP course and average ACT composite score.

This strategy is summarized in the following equation:

$$ACT_{idt} = \beta_0 + \beta_1 AP_i + \beta_2 X_i + \beta_3 Prior_i + \delta_d + \theta_t + u_{idt} \quad \text{Equation 1}$$

where  $ACT_{idt}$  denotes the ACT composite score for each individual student within a given district and exam year. The indicator variable,  $AP_i$ , equals one if the student enrolled in any AP core class between 9th-11th grades, zero otherwise.  $X_i$  is a matrix of individual student characteristics which includes gender, race, eligibility for free- or reduced-price lunch, Limited English Proficiency (ELL) and gifted & talented status. Free- and reduced-price lunch serves as a proxy for students in poverty. I exclude the indicator for ELL designation as it is nearly perfectly collinear with the Hispanic ethnicity variable. District ( $\delta_d$ ) and year ( $\theta_t$ ) fixed effects are included, in addition to prior achievement ( $Prior_i$ ); where prior achievement ( $Prior_i$ ) is the student's 7th grade scale score in math and reading, standardized separately to a z-score and included as two individual covariates (one for math and one for Reading Language Arts). Heteroskedastic robust standard errors are calculated.

In this model,  $\beta_1$  gives the relationship between taking an AP course on ACT performance for a White, male student who neither qualifies for free- or reduced-price lunch nor gifted and talented services and scores at the mean on prior achievement exams. Parameter  $\beta_2$  gives the difference in ACT composite score for each categorical demographic designation, holding all other categories fixed.

While the equation above provides a reasonable estimate of the relationship between taking an AP course on ACT score, it is likely that the relationship is different for students with different demographic characteristics. For example, a student designated as gifted and talented may be more likely to meet prerequisite requirements to enroll in an AP course than a student who qualifies for free- or reduced-price lunch. Students who are better prepared for AP courses may benefit more from taking these classes. On the other hand, students from disadvantaged backgrounds may benefit from the peer effects of being surrounded by high achieving students in the AP classroom. The heterogeneous effect of AP coursework on different student groups is an important aspect of this investigation, therefore we also include an interaction term in a separate model to account for these differences:

$$ACT_{idt} = \beta_0 + \beta_1 AP_i + \beta_2 X_i + \beta_3 (AP_i * X_i) + \beta_4 Prior_i + \delta_d + \theta_t + u_{idt} \quad \text{Equation 2}$$

In this equation, parameter  $\beta_3$  gives the differential effect of taking an AP course for different categorical designations. Using the fitted values for  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$ , we can estimate the average ACT composite score for each subgroup as a function of their AP participation and compare the outcomes.

## V. RESULTS

### *Association Between AP Course-Taking & ACT Composite Score*

Table 4.A depicts the relationship between AP course-taking and ACT composite score for 11<sup>th</sup> grade students in Arkansas between 2016 and 2018. Columns 1-3 in the table increase in specification complexity moving from left to right. Estimates from the preferred model, which includes demographic, prior achievement, and cohort-year and district fixed effects are found in Column 4 of Table 4.A.

*Table 4.A: Relationship Between AP Course-Taking & ACT Composite Score in Arkansas, 2016-2018*

	<b>Basic Regression</b>	<b>Incl. Prior Achievement</b>	<b>Incl. District &amp; Year Fixed Effects</b>	<b>Full Specification</b>	<b>Incl. Interactions</b>
Any Core AP	4.61*** (0.03)	1.62*** (0.01)	2.00*** (0.03)	1.83*** (0.03)	2.57*** (0.05)
Demographic Controls		X	X	X	X
Prior Achievement		X	X	X	X
District Fixed Effects			X	X	X
Cohort Controls			X	X	X
Interactions					X
Constant	17.41*** (0.02)	17.83*** (0.01)	17.72*** (0.17)	18.31*** (0.17)	18.10*** (0.17)
N	76,557	76,557	76,557	76,557	76,557
R-Squared	0.20	0.63	0.63	0.68	0.69

*Note:* \*\*\*Indicates differences are statistically significant at the 1% significance level. Standard errors reported in parentheses. Individual point estimates for demographic, prior achievement, and years can be found in Table 4.B in the Appendix. Contact author for individual district coefficients.



Findings indicate that taking at least one core content Advanced Placement course between 9<sup>th</sup> and 11<sup>th</sup> grade is associated with a statistically significant increase of 1.8 points in ACT composite score. Based on these results, the mean ACT score for a student who took a core content AP course is approximately 20.1 points, compared to 18.3 points for a non-AP taker. Interestingly, this result is clustered around the 19-point cut score required for students to opt out of remedial math and English courses during their freshman year of college in Arkansas.

#### *Heterogeneity by Race and Socioeconomic Status*

The regression results also indicate differences in ACT scores for different subgroups regardless of their AP status (Appendix Table 4.B). For Non-AP Takers, all racial subgroups and students in poverty score below the average White, male, non-FRL student in the dataset. The exception is students who qualify for gifted and talented services, who score almost two points higher than the reference group even without participating in AP.

ACT composite scores also differ by gender, race, GT, and socioeconomic status for students who take Advanced Placement courses. Accounting for differences in outcomes by student subgroups, selecting into an AP core course is associated with a 2.5 point increase in ACT composite score, all else equal (Table 5). This represents the difference in ACT scores for the reference group: a White, male student who takes at least one AP course and does not qualify for gifted & talented services or free- or reduced-price lunch, compared to the counterfactual that does not take any AP.

Table 5, below, depicts estimated ACT scores for an AP-Taker compared to a Non-AP Taker in each categorical designation, obtained using the fitted values for each subgroup and interaction term from Appendix Table 4.B. Mean ACT composite scores for students who select

into AP compared to those who choose not to take AP are both practically and statistically significant and persist regardless of race or socioeconomic background.

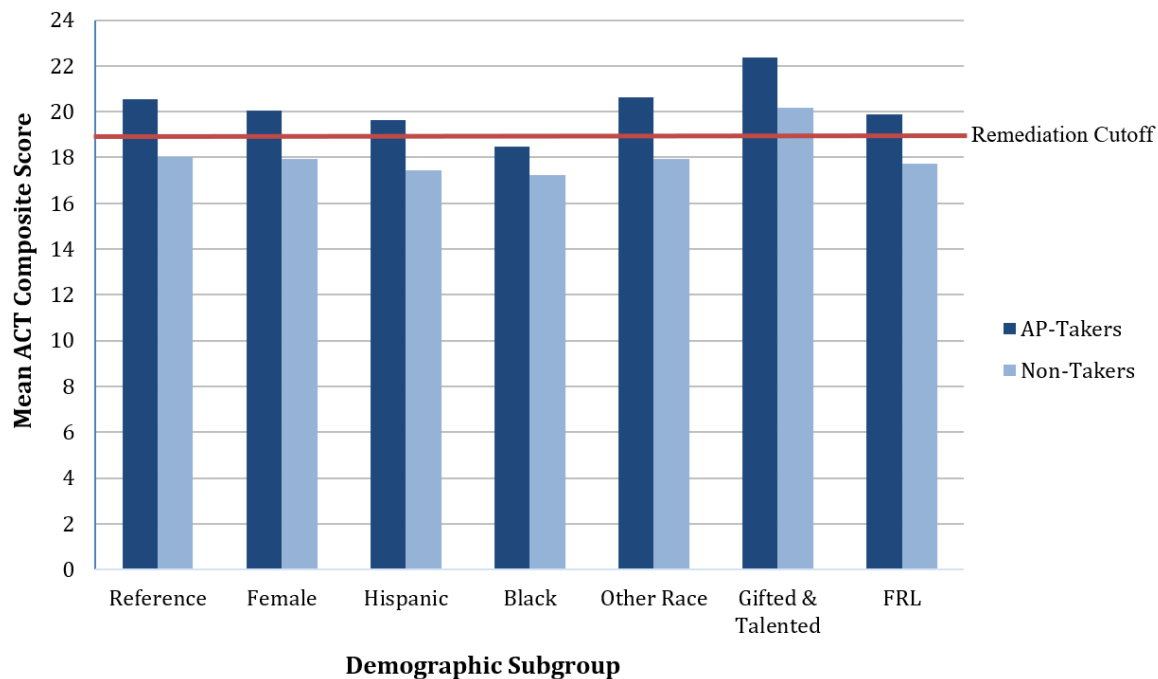
*Table 5: Mean ACT Score for AP-Takers versus Non-Takers for Demographic Subgroups in Arkansas, 2016-2018*

	<b>AP-Takers</b>	<b>Non-Takers</b>	<b>Difference</b>
Reference	20.55	18.03	2.52***
Female	20.03	17.93	2.10***
Hispanic	19.64	17.46	2.18***
Black	18.47	17.22	1.25***
Other Race	20.61	17.93	2.68***
Gifted & Talented	22.36	20.16	2.20***
FRL	19.87	17.73	2.14***
N	24,901	51,656	

*Note.* \*\*\* Indicates differences are statistically significant at the 1% significance level. Source: Author's Calculations.

Although effect sizes for subgroups vary, mean ACT scores for AP-Takers and Non-AP Takers are all clustered around the remediation cut score of 19. Controlling for all other values, on average, students who select into AP score above the remediation threshold while those who do not take AP courses score below the 19 point cutoff. The exception is Black students, where even AP-Takers fail to cross the remediation threshold with an average composite score of approximately 18.5, despite the fact that Black AP-Takers score 1.25 points higher than their Black Non-AP peers. Figure 1 demonstrates the difference in mean ACT score for AP-Takers and Non-Takers in each subgroup relative to the 19 point college remediation cut score.

Figure 1: Mean ACT Composite Score for AP-Takers versus Non-Takers in Arkansas, 2016-2018



Note: Red line represents 19 point college remediation cut score value.

### Robustness Checks

To check the robustness of the estimates from the main analysis, a number of alternative specifications are tested. Tables 6 and 7 in the Appendix show results of these robustness checks which included implementing regional fixed effects in place of district fixed effects and utilizing nearest neighbor propensity score matching with both district, and then regional, fixed effects. Employing regional fixed effects accounts for heterogeneity between different regions of Arkansas, who tend to have dissimilar population sizes, demographic distributions, and varying levels of socioeconomic status. Additionally, for policy purposes, the Arkansas Department of Education tends to analyze trends regionally.

The same regression with observable covariates (Equation 1) is employed when running this model, with regional dummies substituted for district fixed effects. Results indicate that,

holding all else fixed, individuals who select into AP courses, on average, score 1.5 points higher on their ACT relative to individuals who opt out of AP coursework (Appendix Table 6).

Allowing for heterogeneity amongst AP-Takers with regional fixed effects (Equation 2) shows that AP-Takers score, on average, approximately 2.3 points higher on the ACT compared to Non-AP Takers. These point estimates are on par with those from the main analysis and demonstrate results are robust to the inclusion of regional comparisons.

Nearest neighbor propensity score matching is also employed to determine if effect size persists when utilizing a different method. First, a propensity score is generated for the likelihood of taking at least one AP core course between 9<sup>th</sup> -11<sup>th</sup> grade. Propensity scores are then used to generate a nearest neighbor match, using replacement, to determine the average treatment effect for those who took AP core courses compared to similar students who did not take any AP courses. This procedure is replicated with both regional and district fixed effects. The results of the matching approach (see Appendix Table 7) demonstrate AP-Takers score 1.2 and 1.3 points higher on the ACT relative to Non-AP Takers on average, in specifications with district and regional fixed effects, respectively. While the effect sizes with the matching approach are smaller than those obtained through linear regression, the difference is still large enough to place AP-Takers above the 19 point remediation cut score compared to Non-Takers.

## **VI. DISCUSSION & KEY TAKEAWAYS**

This paper estimates the difference in mean ACT composite score for students who select into core content Advanced Placement courses between 9<sup>th</sup> to 11<sup>th</sup> grades, compared to individuals who do not take any core AP courses. In particular, this study focuses on 11th-grade students in Arkansas who took the ACT school-day exam between 2016 and 2018. Results indicate that students who select into AP courses in 9<sup>th</sup> -11<sup>th</sup> grade attain higher ACT composite scores relative to their peers, even when controlling for covariates.

There is also evidence that race and socioeconomic status moderate the size of the effect of AP course-taking. Subgroups from racially diverse or economically disadvantaged backgrounds both score lower on the ACT, on average, and experience smaller increases in ACT composite score when taking AP courses, compared to their economically advantaged, White peers. In addition to the regression outputs, the descriptive statistics tell a story of gaps in advanced course-taking and college readiness in Arkansas. These findings have implications for policymakers wishing to leverage Advanced Placement coursework to improve student outcomes for students from historically underserved backgrounds.

It is also important to note the practical significance of the clustering phenomena uncovered in this study. The finding that AP-Takers tend to score above the 19 point remediation cut score and Non-AP Takers generally score below could be a function of two mechanisms. First, we could assume that the difference in ACT composite score for the two groups is a function of taking an AP course. In this scenario, AP coursework improves student outcomes through some unknown causal mechanism such as peer effect, teacher quality, or the AP curriculum itself. An alternative story is that students self-select into, or out of, AP based on their

self-perceived college readiness or college-going aspirations. The difference in scores, therefore, may simply be capturing the effect of motivation or parental or teacher influence, none of which are captured in this analysis.

This story is interesting to consider, given that statewide policies such as Arkansas Act 102, are calling for increased participation in Advanced Placement. It is possible that these policies may end up “pushing” students into AP who are not ready, either academically or socio-emotionally. The question still remains whether students induced to take AP will experience the hypothesized benefits of the coursework. This study, being merely descriptive in nature, is unable to determine whether AP courses cause students to score higher on the ACT, but future research on such topics would be beneficial in understanding how to prepare students for the rigors of college.

Regardless of the causal mechanism, the clustering phenomenon around the remediation threshold may have later life implications for students in Arkansas. In an evaluation of Arkansas’ Developmental Coursework Policy, Rhinesmith (2017) finds that students required to take remedial courses experience negative impacts on persistence and degree attainment, regardless of institution type.

This finding underlines the importance of understanding the true impact of AP course-taking on student outcomes on the ACT. If, in fact, AP courses can move the needle for students on the standardized test, then increasing participation may have significant positive impacts for students later in life. Alternatively, if students are self-selecting out of AP based on their perceived college-readiness it also indicates that more support is needed for those subgroups in

terms of gaining the skills and knowledge needed to achieve better results on the ACT exam. Nevertheless, this finding warrants more investigation.

It should be noted that a number of limitations exist in this study. First, we are unable to control for all factors that may influence a student to enroll in an Advanced Placement course. For example, parental influence has been shown to account for up to 60% of the motivational factors which cause students to take advanced coursework such as AP (Warne, 2017). Parental education may also play a role in college-going motivation and therefore choices to take AP or other college-level classes. Since teachers also have sway over some level of student decision-making when it comes to coursework, there could be a benefit to accounting for the clustering of students within classrooms in future investigations.

In addition, the quality of an AP teacher may greatly mediate student outcomes, therefore including a measure of teacher value-added may benefit studies such as this. Besides these factors, we are missing information about the selection criteria each district uses to determine which students are eligible for Advanced Placement courses. Therefore, these results only give the effect of AP coursework on ACT scores assuming every student has an equal chance of participation after controlling for the included covariates. Correcting this assumption could help make the estimated effect more accurate. Furthermore, we do not have AP test scores for these individuals, so we are only able to estimate the impact of taking the course, but not passing the exam. It is possible that students who take the course and pass the AP exam may score differently on the ACT relative to students who do not pass the end-of-course exam.

Further studies would benefit from addressing the limitations listed above, in addition to investigating which mechanism of AP coursework leads to the observed differences in score.

Moreover, a study specifically focusing on those students “induced” to take AP courses, who would have otherwise opted to take non-AP coursework, could be of interest in order to attempt to determine the impact of Advanced Placement in the absence of strong motivating factors.

Other possible investigations include examining the relationship between the dosage of Advanced Placement courses taken and student outcomes or determining if there is heterogeneity in effect sizes based on the type of AP course taken. A simple study could include 12th graders in the analysis to have a more complete picture of course-taking habits and ACT composite score. Since most schools utilize the “Super Score” from the ACT, combining the top scores from each section over multiple exams, a student who retakes the exam is likely to improve their score. Therefore, “re-takers” could influence the effect size of the findings.

Similarly, students may take more AP courses in 12th grade, changing the results in other ways. Determining the relationship between AP course-taking and college-going rates, and college outcomes is of great interest if high school records can be linked to individuals at the university level. Future studies could also leverage the policy change in Arkansas to employ a difference-in-differences approach in order to try and estimate the causal impact of AP course-taking on student outcomes.

This study contributes to the literature on AP student outcomes through the use of subgroup analysis and statistical methods that control for confounding variables. It is also the first analysis of this type to look at student outcomes specifically in the state of Arkansas. The practical findings of the relationship between AP-taking and college remediation warrant further discussion and study, as it could have direct later life consequences for students. Ultimately, the implications of this research will help provide evidence of the link between AP coursework and



student achievement. Further research on this topic is needed, especially studies that may be able to provide causal interpretations.

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## APPENDIX

*Table 4.B: Relationship Between AP Course-Taking & ACT Composite Score in Arkansas, 2016-2018*

	<b>Basic Regression</b>	<b>Incl. Prior Achievement</b>	<b>Incl. District &amp; Year Fixed Effects</b>	<b>Full Specification</b>	<b>Incl. Interactions</b>
Any Core AP	4.59*** (0.03)	1.60*** -0.01	2.00*** (0.03)	1.78*** (0.03)	2.52*** (0.05)
zMath		2.76*** -0.02	2.67*** (0.02)	2.24*** (0.02)	2.52*** (0.05)
zRLA		1.19*** -0.02	1.06*** (0.02)	1.04*** (0.02)	2.33*** (0.02)
District FE			X	X	X
2017 Cohort			-0.08*** (0.03)	-0.37*** (0.02)	-0.39*** (0.02)
2018 Cohort			-0.19*** (0.02)	-0.47*** (0.02)	-0.49*** (0.02)
Female				-0.24*** (0.02)	-0.10*** (0.02)
Black				-1.16*** (0.03)	-0.78*** (0.04)
Hispanic				-1.16*** (0.04)	-1.06*** (0.04)
Other Race				-0.17*** (0.06)	-0.25*** (0.07)
FRL Status				-0.47*** (0.02)	-0.32*** (0.03)
GT Status				1.94*** (0.04)	2.13*** (0.07)
Black*AP					-1.30*** (0.06)
Hispanic*AP					-0.29*** (0.08)

	Basic Regression	Incl. Prior Achievement	Incl. District & Year Fixed Effects	Full Specification	Incl. Interactions
Other Race*AP					0.18  (0.12)
FRL*AP					-0.42*** (0.05)
GT*AP					-0.34*** (0.08)
Female*AP					-0.45*** (0.04)
Constant	17.43*** (0.02)	17.77*** (0.01)	17.72*** (0.17)	18.34*** (0.17)	18.1*** (0.17)
N	76,557	76,557	76,557	76,557	76,557
R-Squared	0.2	0.63	0.63	0.68	0.69

*Note.* \*\*\* Indicates differences are statistically significant at the 1% significance level. Standard errors reported in parentheses. Contact author for individual district coefficients.

*Table 6: Effect of AP Course-Taking on ACT Composite Score using Regional Fixed Effects, 2016-2018*

	Preferred Model	Incl. Interactions
Constant	18.85 (0.03)	18.60 (0.03)
Any AP	1.54*** (0.03)	2.28*** (0.05)
zMath	2.36*** (0.02)	2.34*** (0.02)
zRLA	1.07*** (0.02)	1.09*** (0.02)
Regional FE	<i>See Note</i>	<i>See Note</i>
2017 Cohort	-0.37*** (0.03)	-0.36*** (0.02)
2018 Cohort	-0.45*** (0.02)	-0.44*** (0.02)
Female	-0.22*** (0.02)	-0.06*** (0.02)
Black	-1.16*** (0.03)	-0.83*** (0.03)
Hispanic	-0.60*** (0.05)	-0.46*** (0.06)
Other Race	0.14** (0.06)	0.08 (0.07)
FRL Status	-0.67*** (0.02)	-0.54*** (0.03)
GT Status	1.90*** (0.04)	2.11*** (0.07)
Black*AP		-1.15*** (0.06)
Hispanic*AP		-0.40*** (0.12)
Other Race*AP		0.14 (0.12)
FRL*AP		-0.34*** (0.05)
GT*AP		-0.40*** (0.08)
Female*AP		-0.50*** (0.04)
N	76,557	76,557
R-Squared	0.67	0.67

*Note.* \*\*\* Indicates results are statistically significant at the 1% significance level, \*\* indicates results are statistically significant at the 5% significance level. Standard errors reported in parentheses. Contact author for individual regional coefficients.

*Table 7: Estimated Effect of AP Course-Taking on ACT Scores Using Nearest Neighbor Propensity Score Matching, 2016-2018*

	<b>District Fixed Effects</b>	<b>Regional Fixed Effects</b>
Average Treatment Effect (AP-Takers)	1.24***	1.34***
	(0.04)	(0.04)

*Note.* \*\*\* Indicates differences are statistically significant at the 1% significance level. Standard errors are reported in parentheses.